

Figure 1

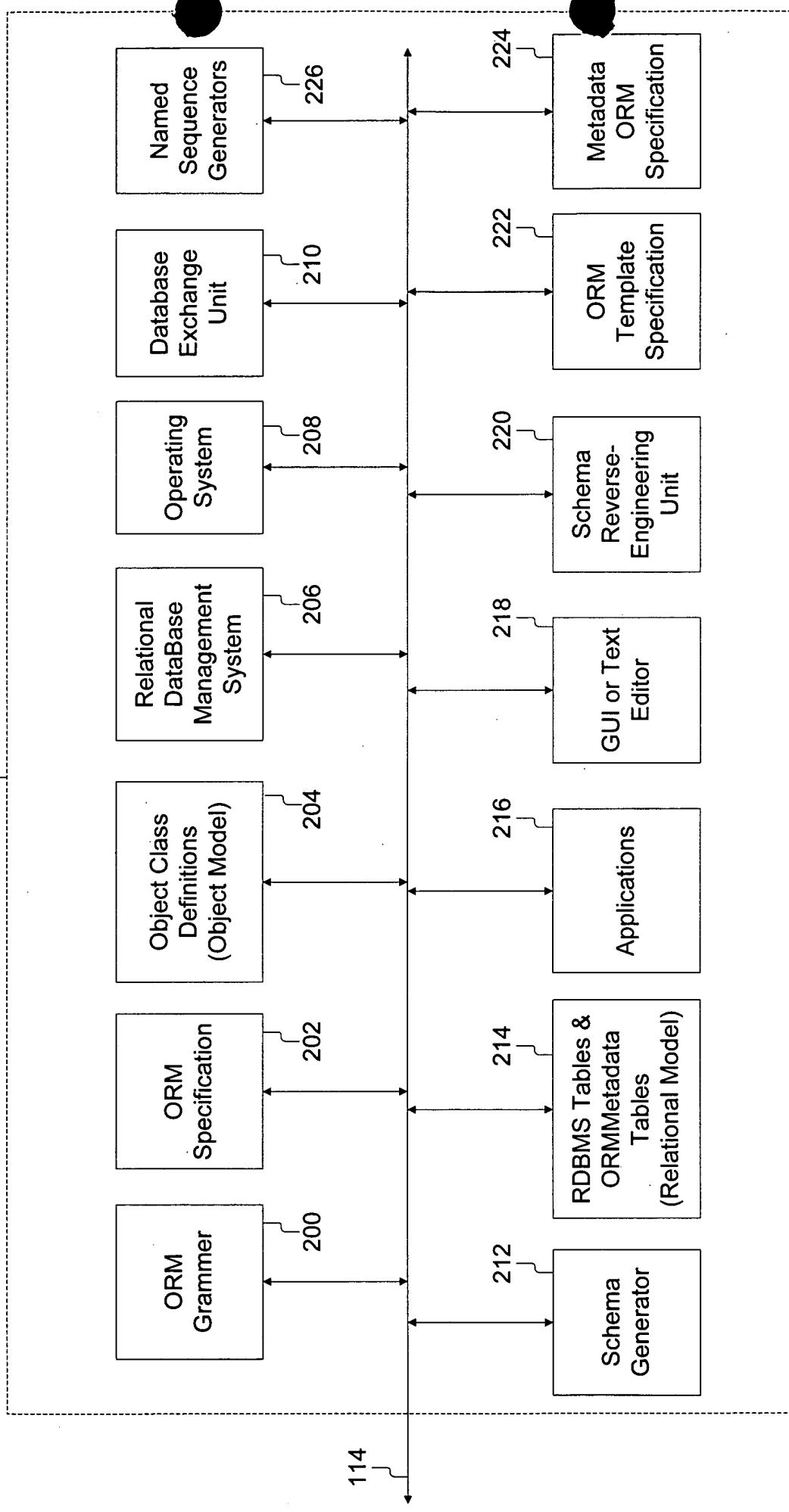


Figure 2

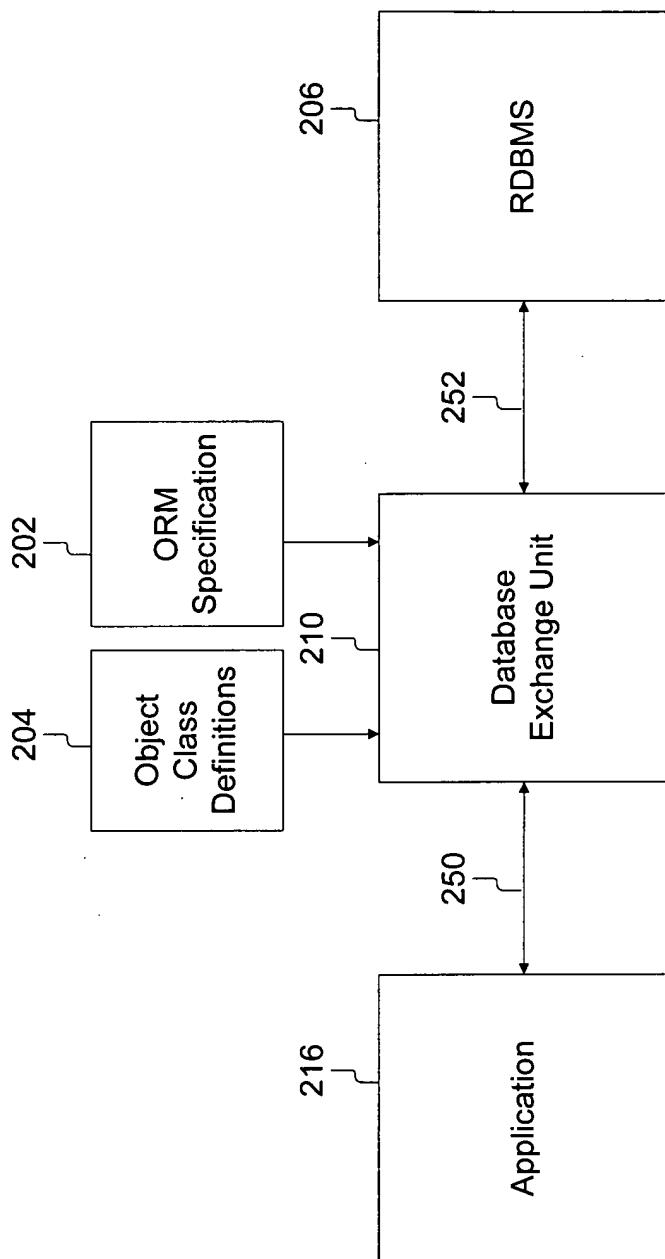
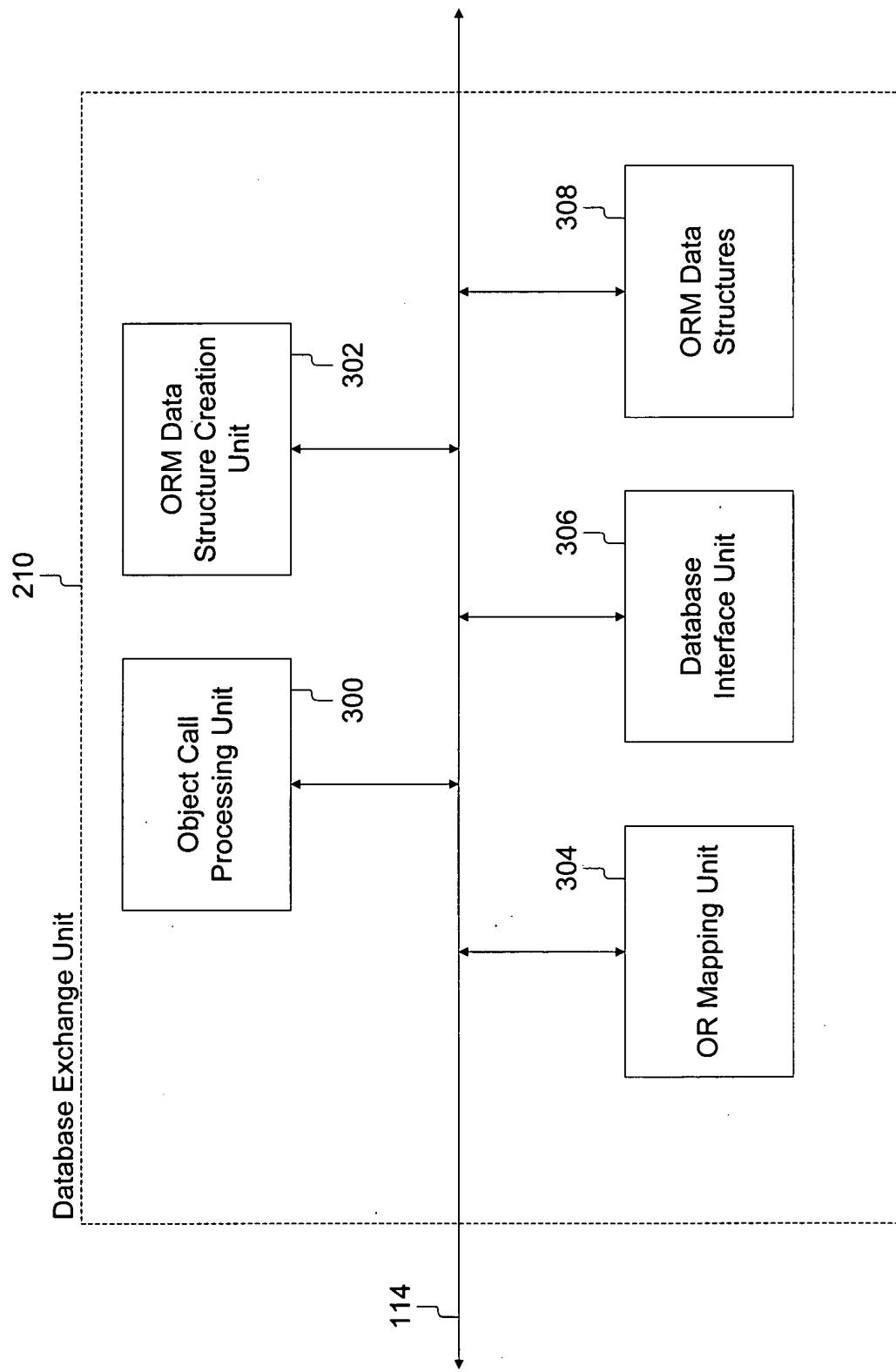


Figure 3

Figure 4



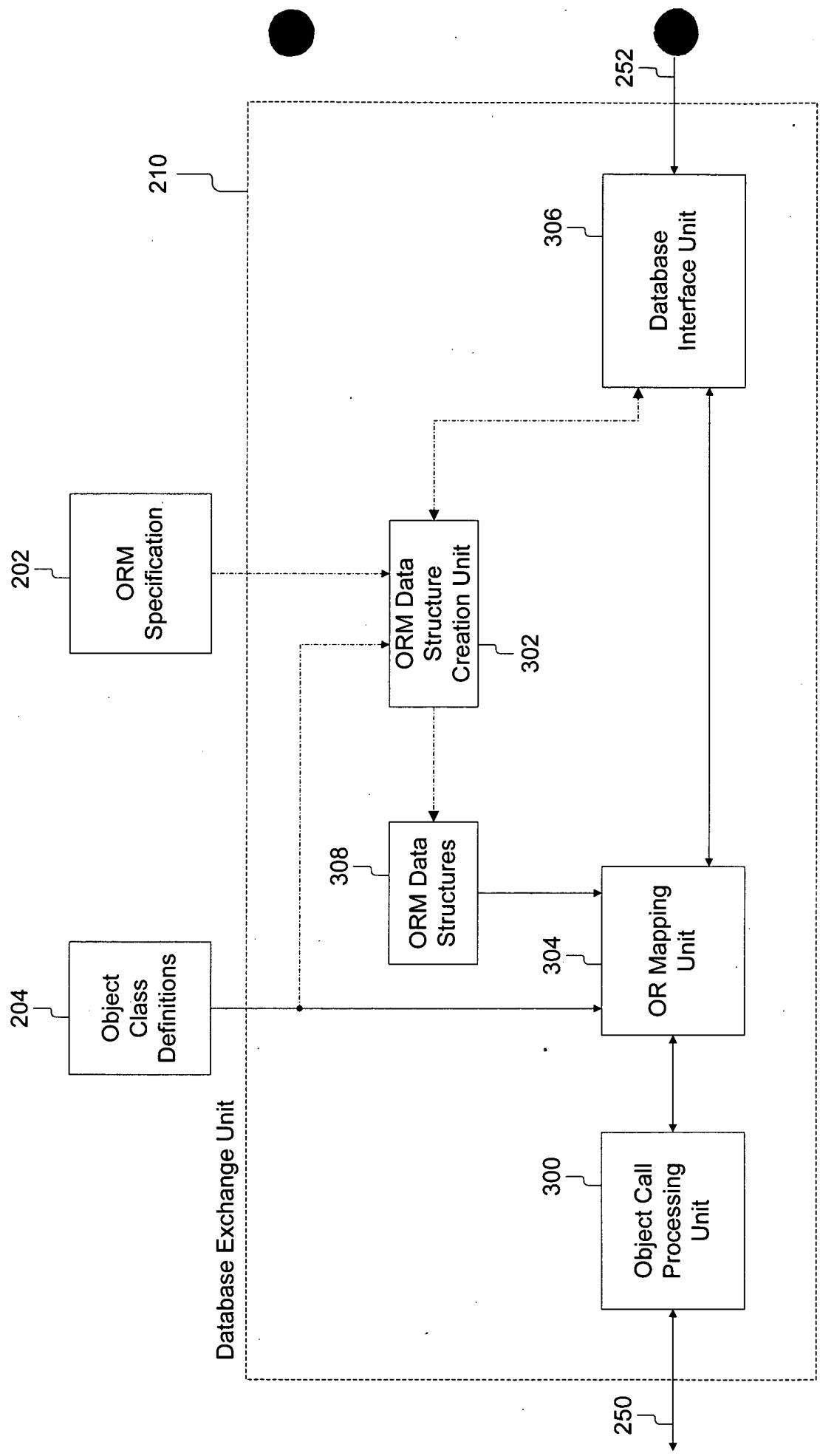


Figure 5

# Figure 6

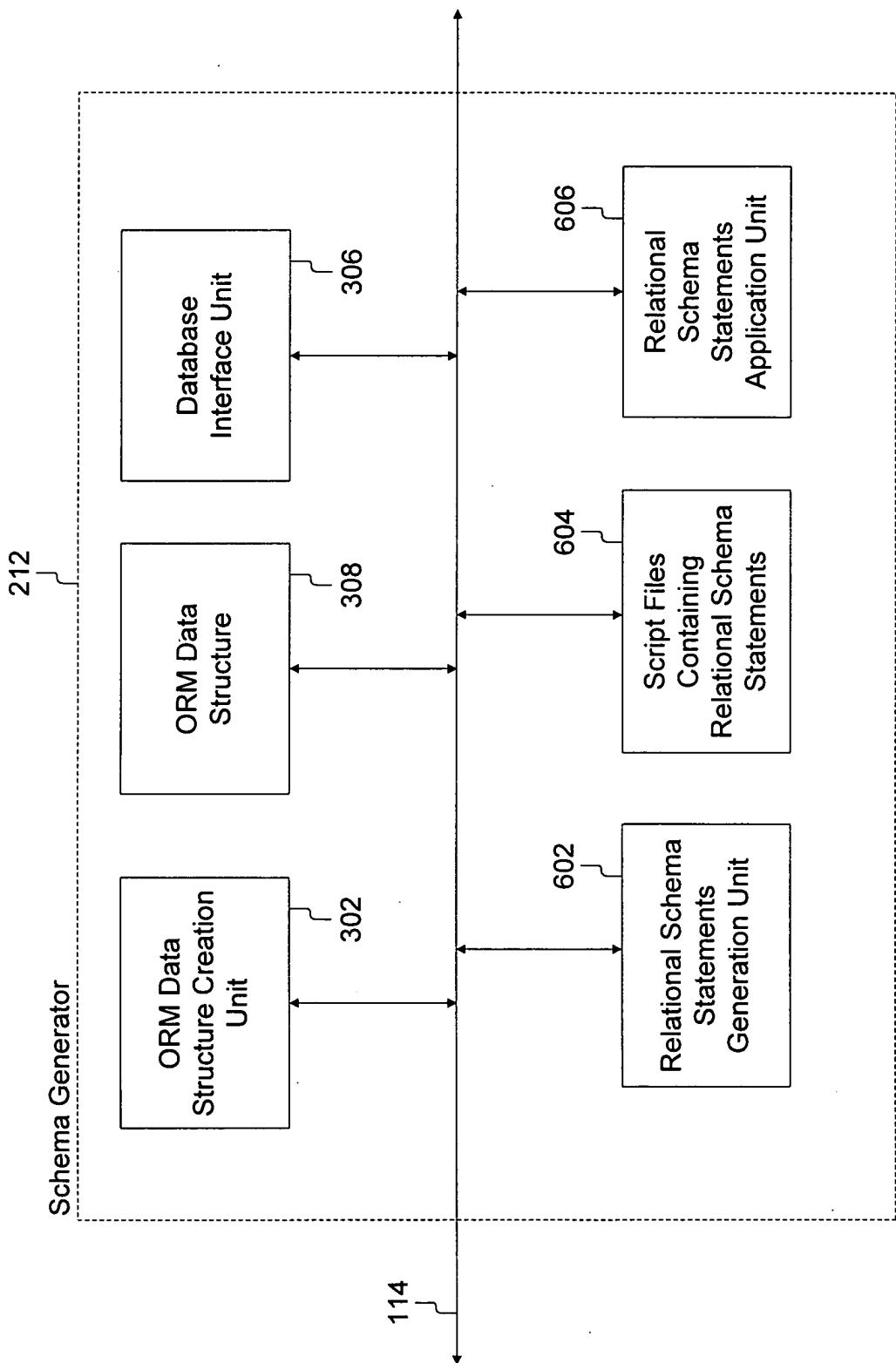
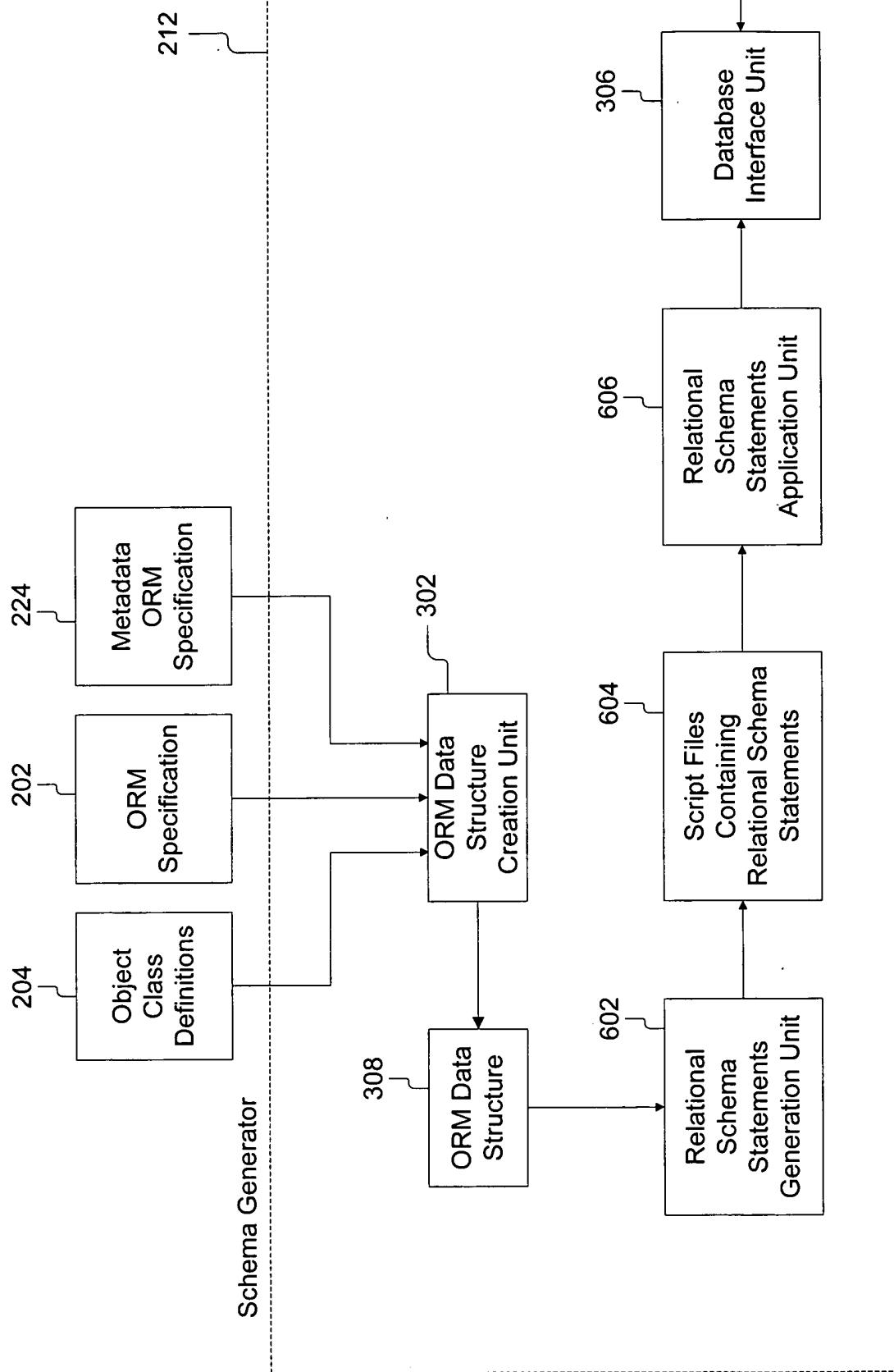


Figure 7

Object Class Definitions → ORM Specification → Metadata ORM Specification



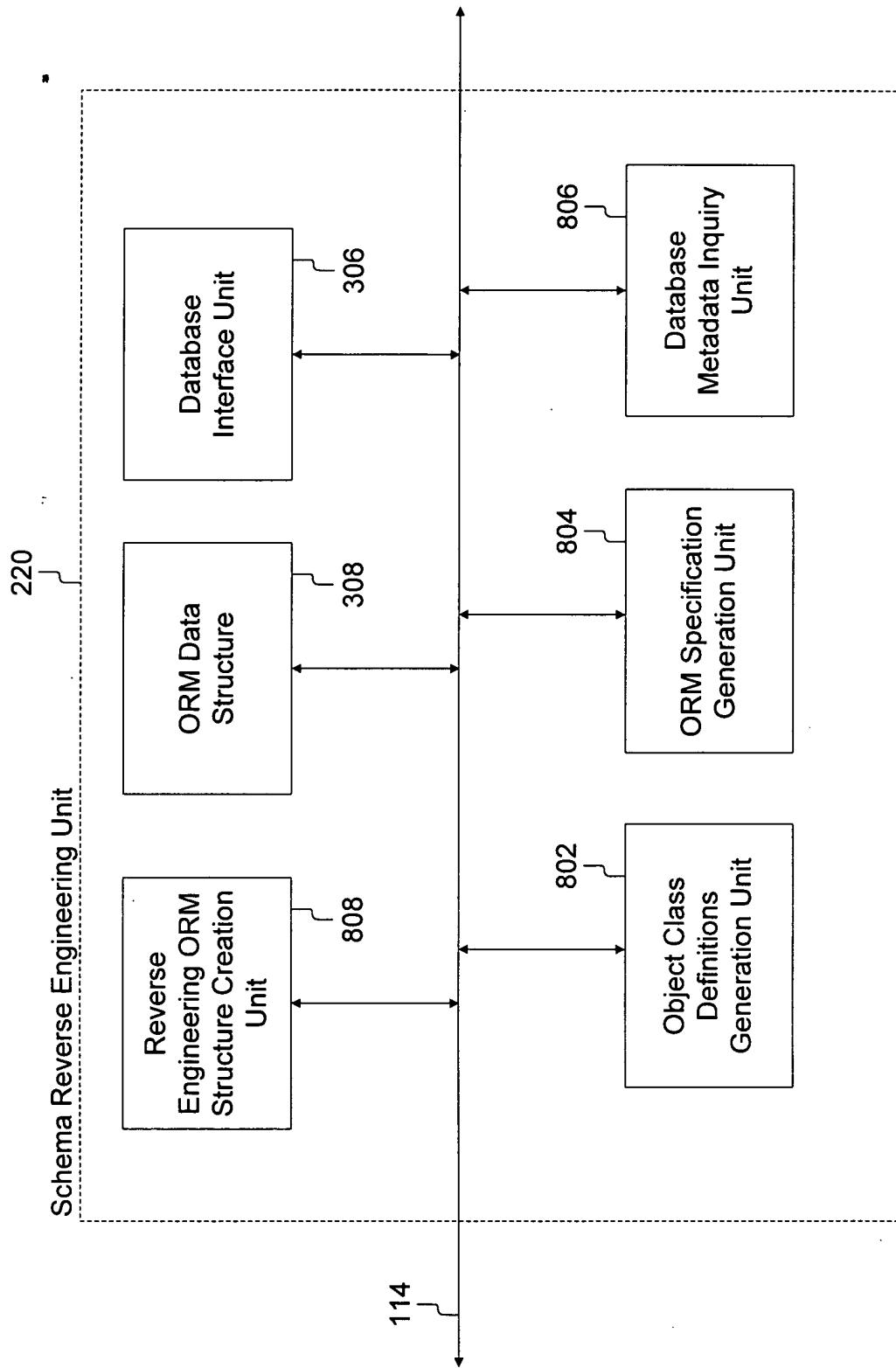


Figure 8

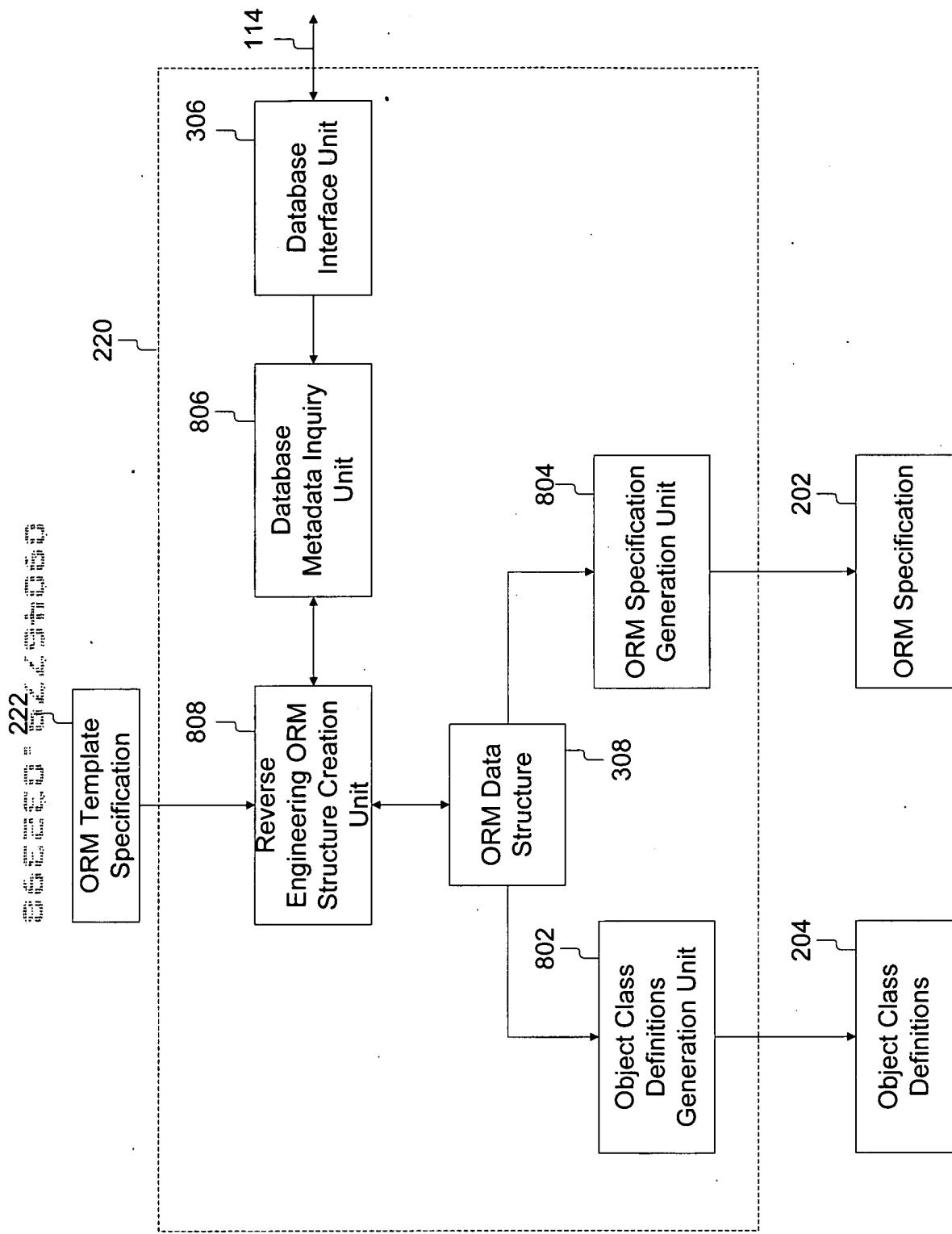
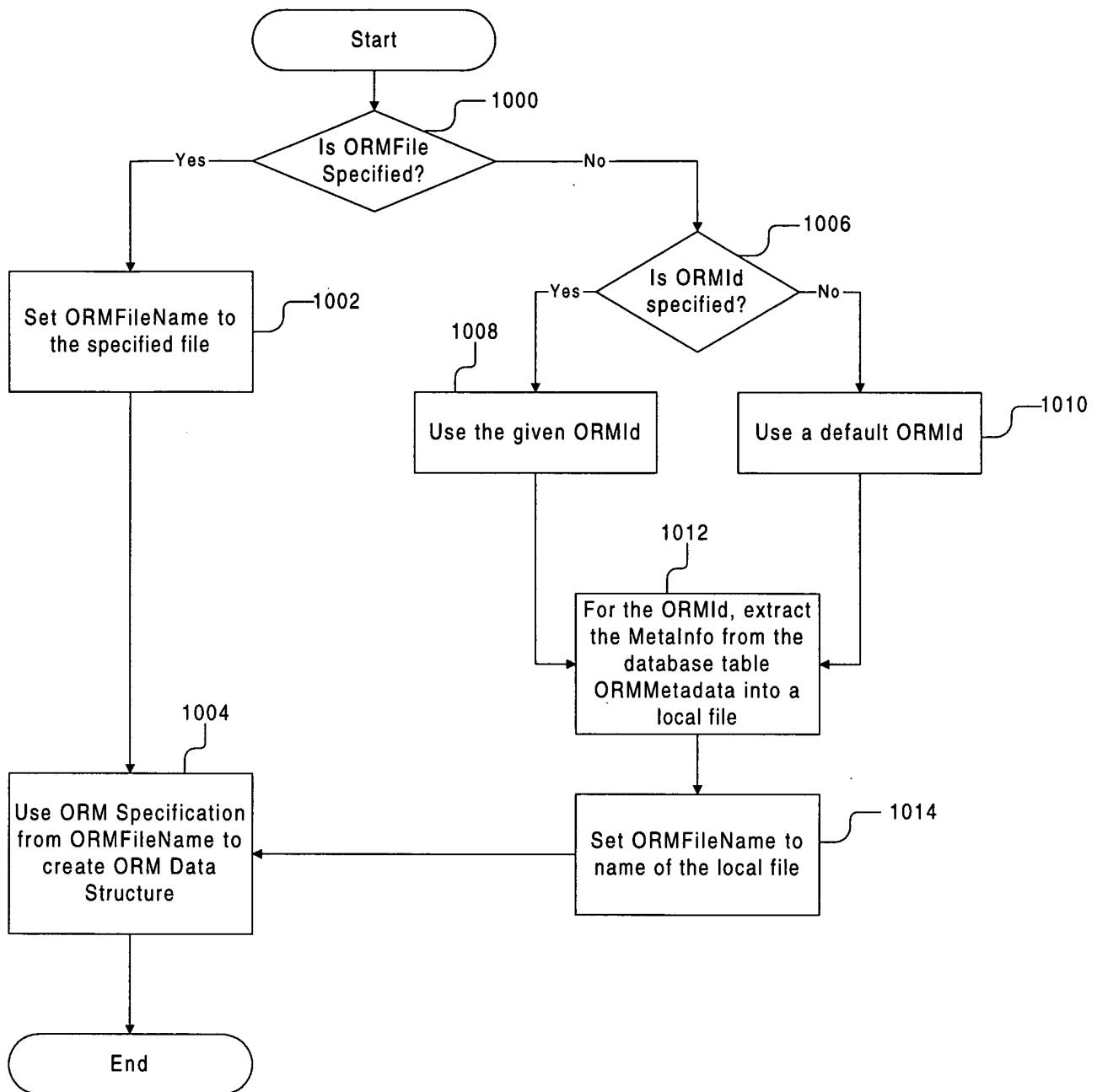


Figure 9



# Figure 10

Method for using ORM specification based on an existing ORMid or an ORMfile to create an ORM Data Structure

Method For Generating ORM Data Structures from an ORM Specification and Object Class Definitions

Figure 11

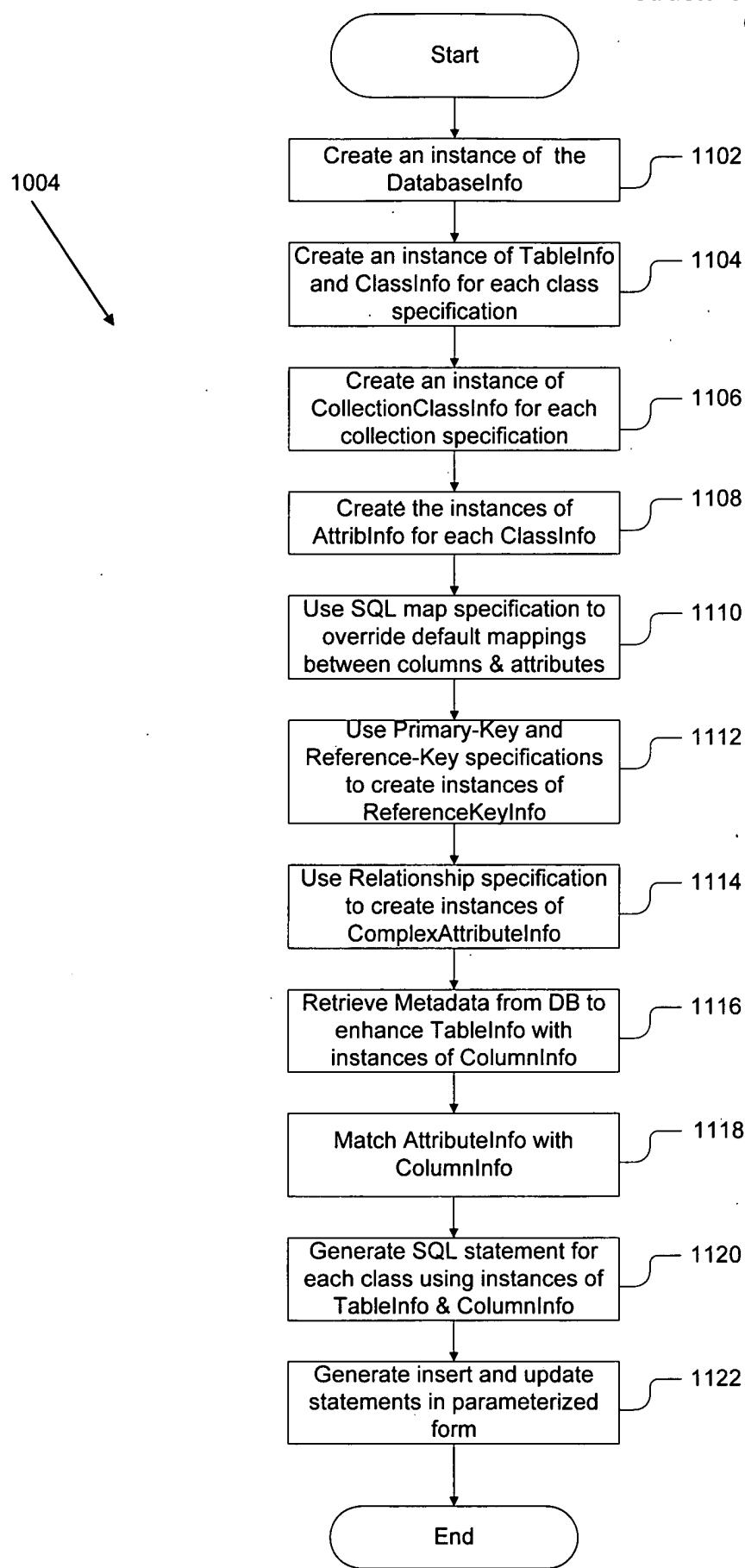
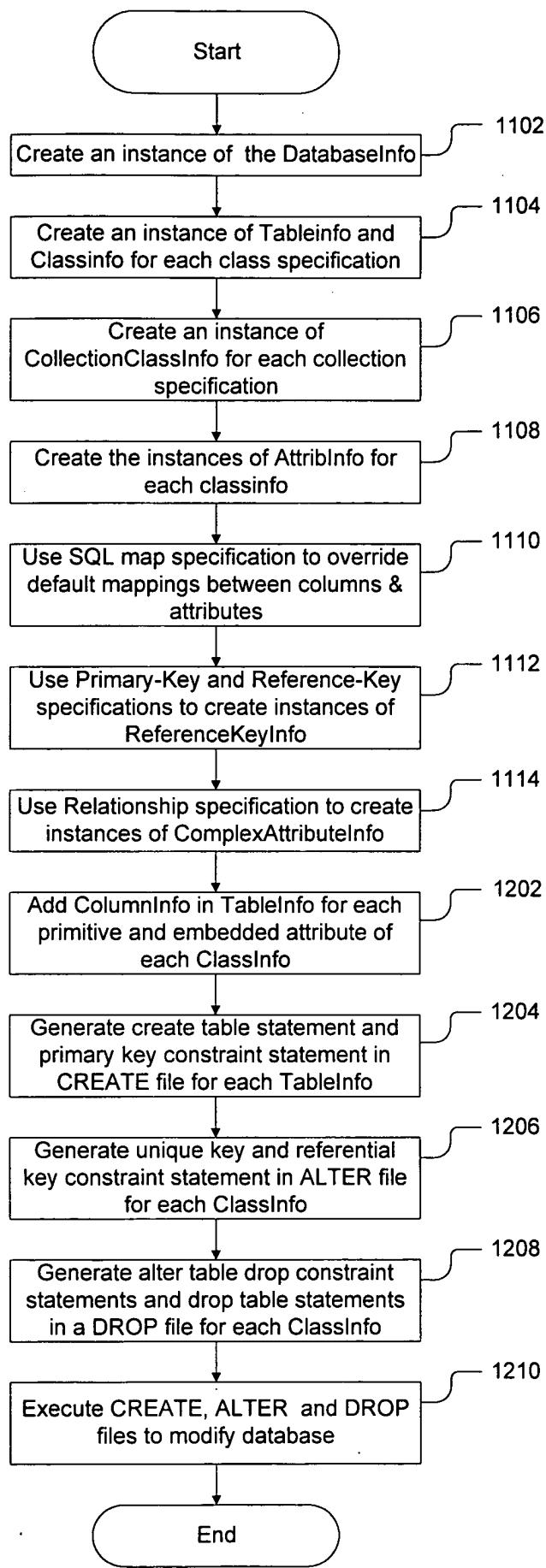
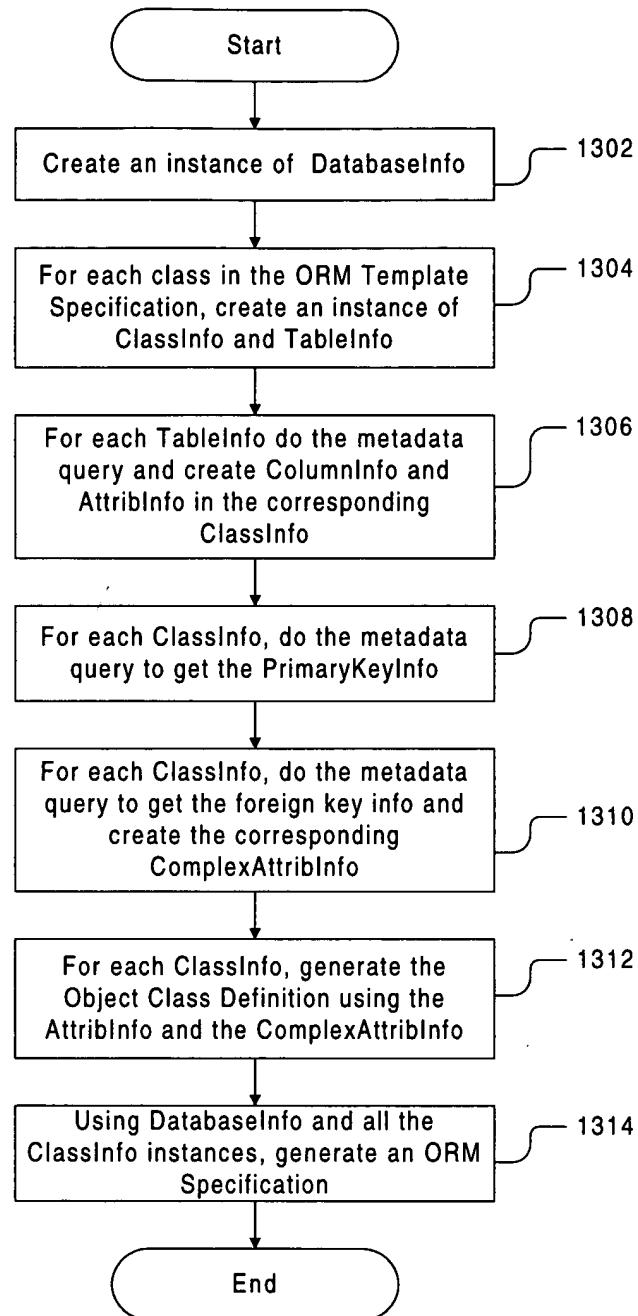


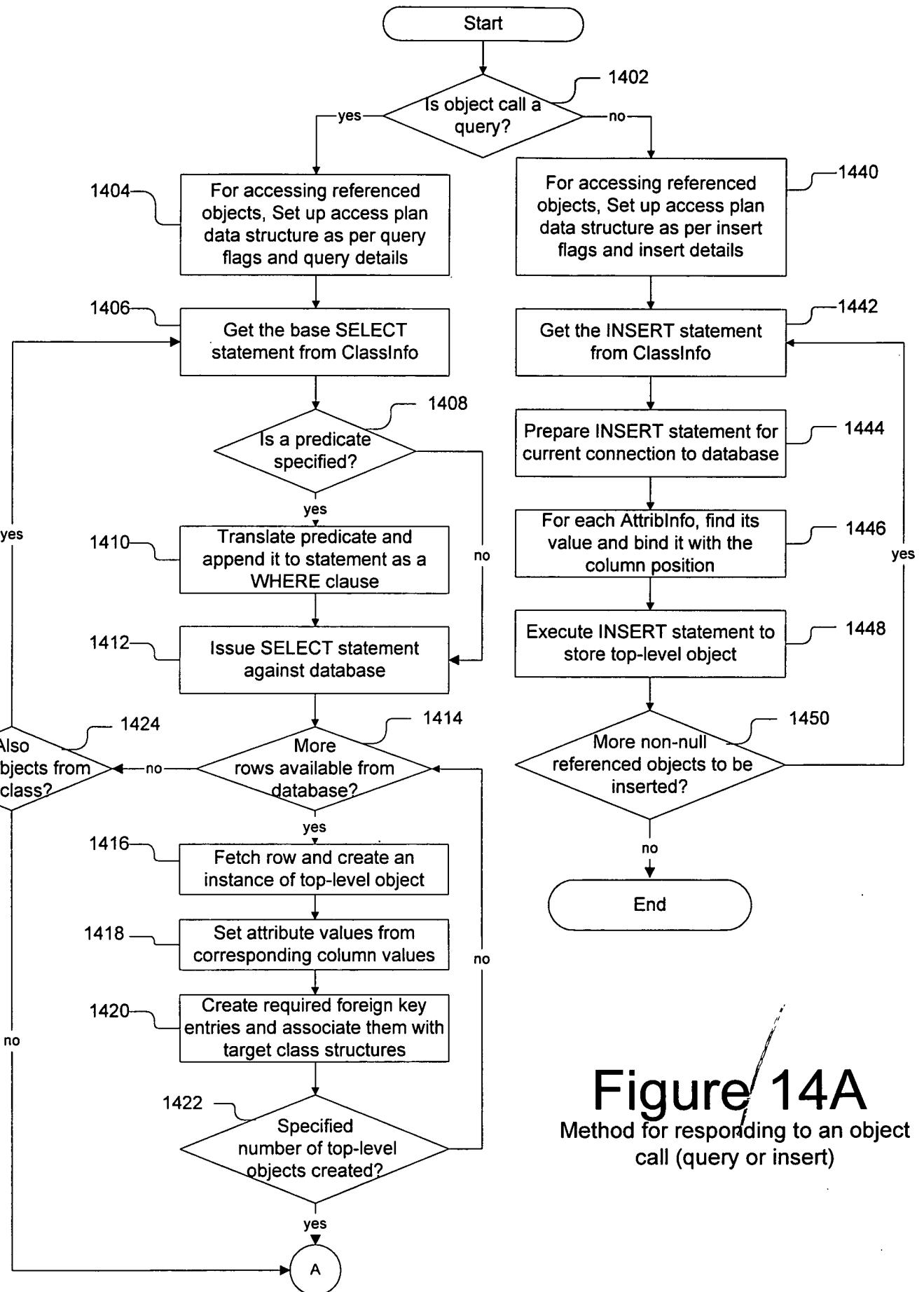
Figure 12





# Figure 13

Method for generation of an ORM Specification and an Object Class Definition from a database schema



**Figure 14A**  
Method for responding to an object call (query or insert)

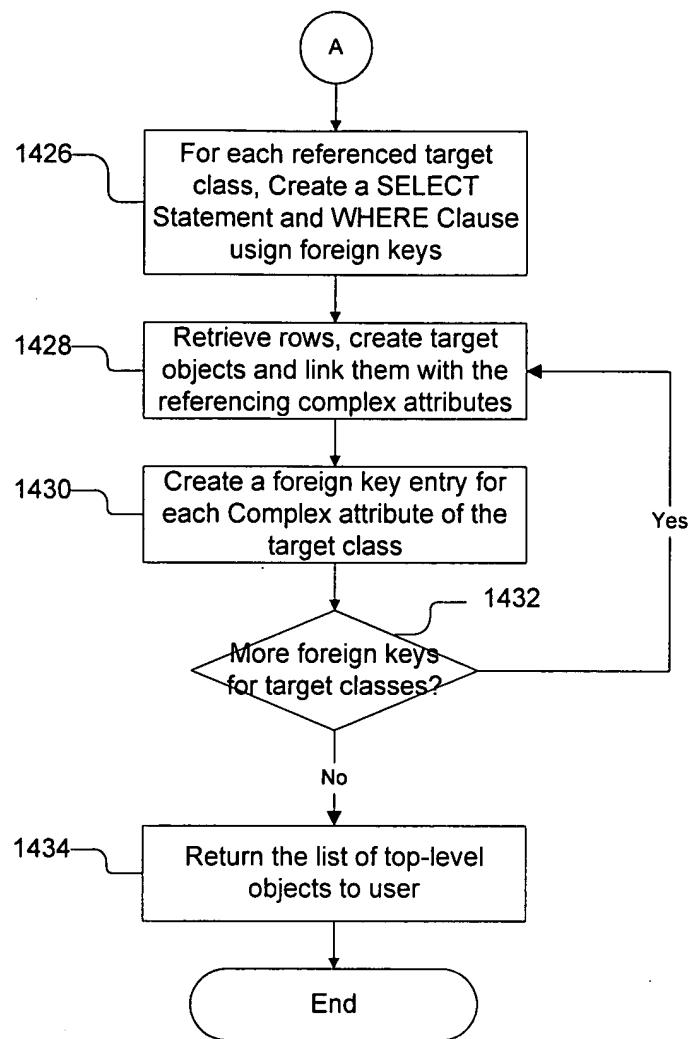
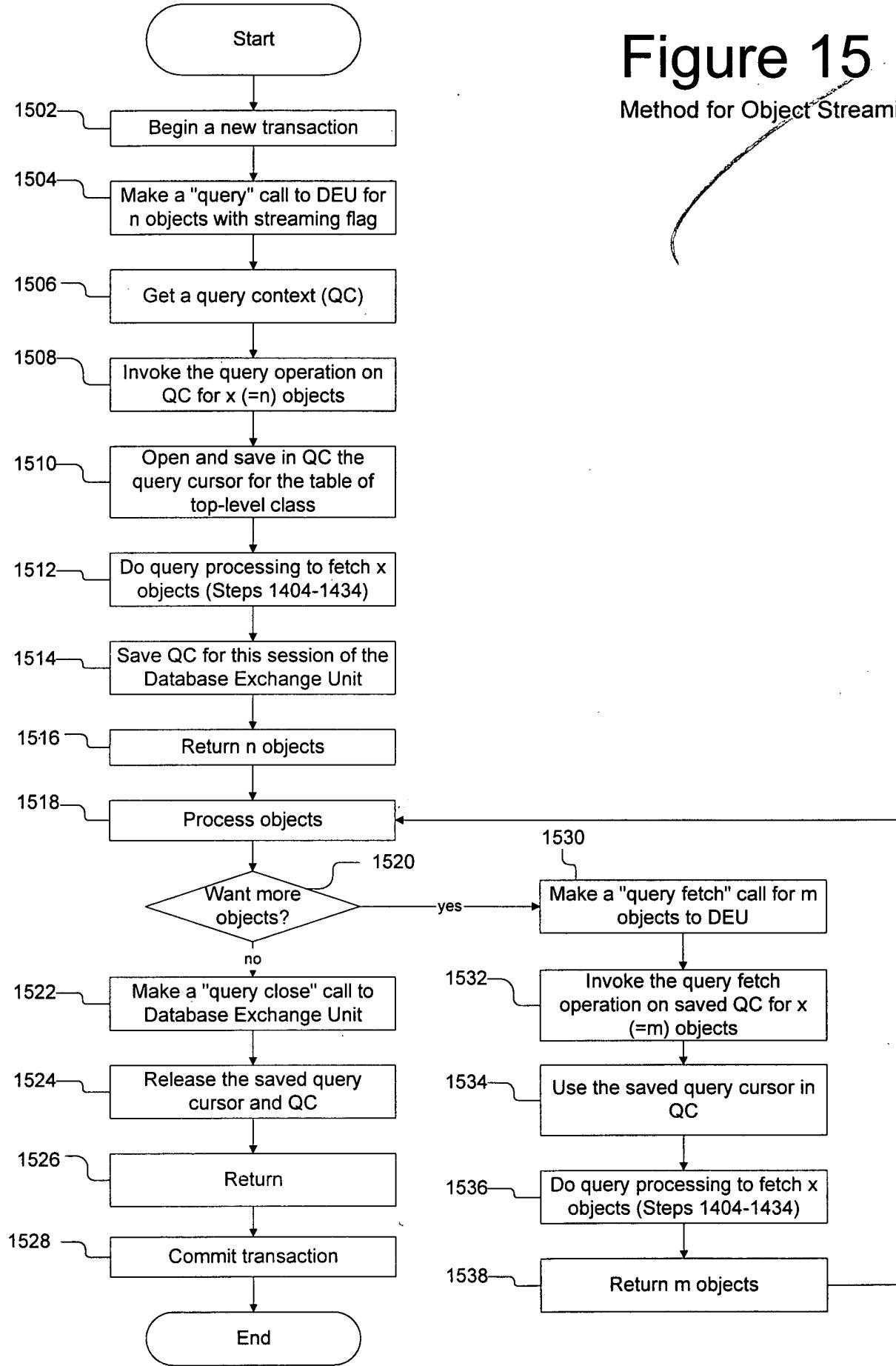
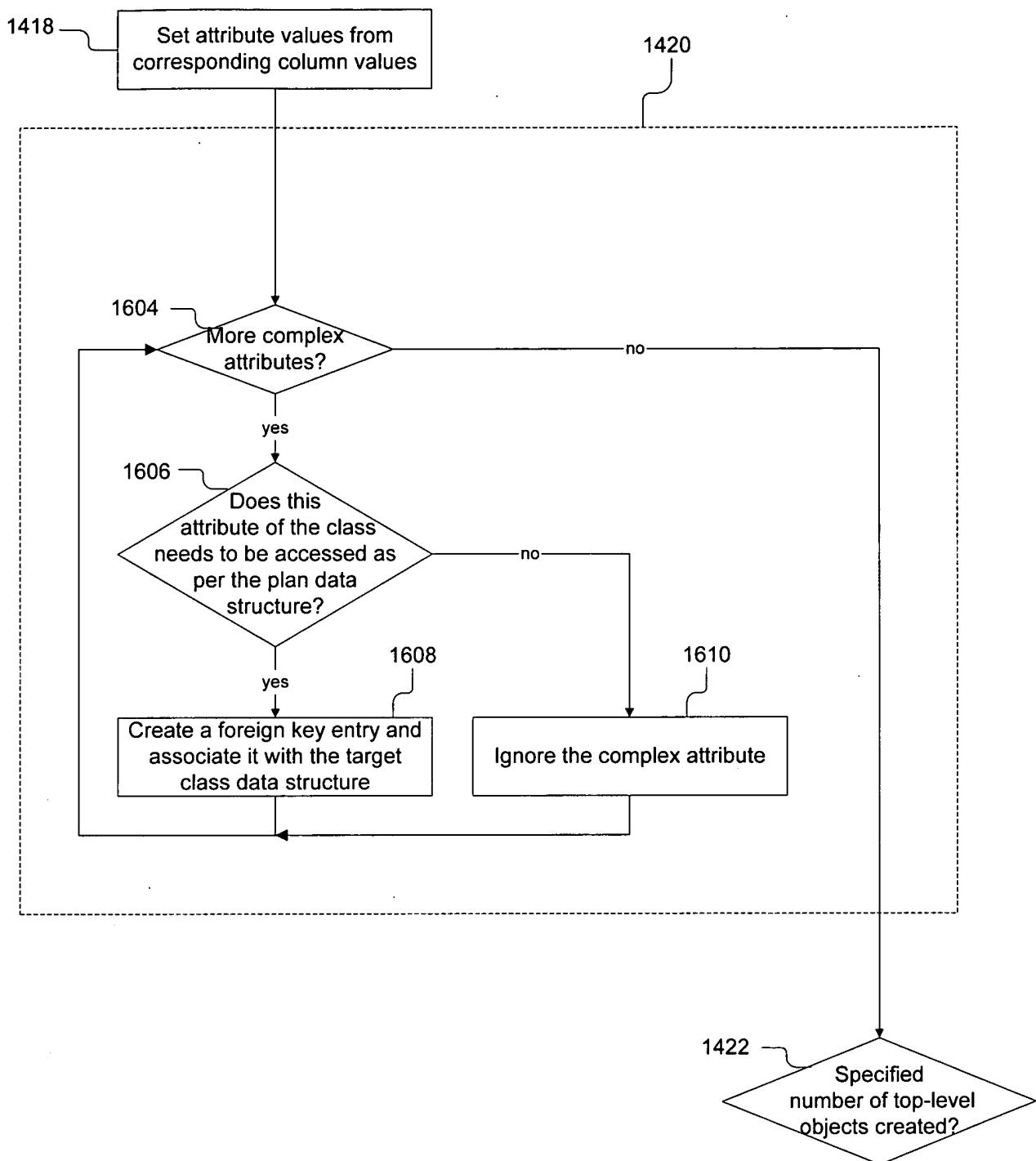


Figure 14B

# Figure 15

Method for Object Streaming





**Figure 16**  
 Method for Using Directed Operations for a Query Operation

```

<ORM-INFO>           ::= [ ;ORMId=<ORMId> ] [ ;ORMFile=<fileName> ]

<DATABASE-URL>      ::= <regularURL> [ <ORM-INFO> ]

<ENDDATABASE-SPEC>  ::= ;

<DATABASE-SPEC>      ::= DATABASE <DATABASE-URL>
                           <ENDDATABASE-SPEC>

<PRIMARY-KEY-SPEC>   ::= PRIMARY_KEY { <attribName> ... }

<REFERENCE-KEY-SPEC> ::= REFERENCE_KEY <referenceKeyName>
                           { <attribName> ... }

<SQLMAP-SPEC>        ::= SQLMAP FOR <attribName>
                           [ COLUMN_NAME <columnName> ]
                           [ SQLTYPE <sqlType> ]
                           [ NULLABLE ]

<RELATIONSHIP-SPEC>  ::= RELATIONSHIP <attribName> REFERENCES <targetClassName>
                           { EMBEDDED | [ BYVALUE ] [ REFERENCED_KEY
                           <referencedKeyName> ] WITH <attribName> ... }

<ENDCLASS-SPEC>       ::= ;

<CLASS-SPEC>          ::= CLASS <className> [ TABLE <tableName> ]
                           <PRIMARY-KEY-SPEC>
                           [ <REFERENCE-KEY-SPEC> ... ]
                           [ <SQLMAP> ... ]
                           [ <RELATIONSHIP-SPEC> ... ]
                           <ENDCLASS-SPEC>

<ORDERBY-SPEC>        ::= ORDERBY { <attribName> ... }

<COLLECTION-CLASS-SPEC> ::= COLLECTION_CLASS <className>
                           COLLECTION_TYPE { ARRAY | VECTOR }
                           ELEMENT_CLASS <elelemtClassName>
                           [ ELEMENT_TABLE <elementTableName> ]
                           <PRIMARY-KEY-SPEC>
                           [ <ORDERBY-SPEC> ]
                           <ENDCLASS-SPEC>

<SEQUENCE-SPEC>        ::= SEQUENCE <sequenceName>
                           MAX_INCREMENT <maxIncrementValue>
                           [ START_WITH <startingVal> ]

<ORM-SPEC>            ::= <DATABASE-SPEC>
                           Any combination of <CLASS-SPEC>,
                           <COLLECTION-CLASS-SPEC>,
                           <SEQUENCE-SPEC> and <REMARK-SPEC>

```

## FIGURE 17

### ORM Grammar

```
 DATABASE jdbc:odbc:sqlpubs;user=guest;password=hello;ORMId=pubs01
;
REM
CLASS RoySched TABLE roysched
PRIMARY_KEY title_id lorange
;
COLLECTION_CLASS ArrayRoySched COLLECTION_TYPE ARRAY
ELEMENT_CLASS RoySched
PRIMARY_KEY title_id
ORDERBY royalty
;
CLASS Title TABLE titles
PRIMARY_KEY title_id
RELATIONSHIP royscheds REFERENCES ArrayRoySched BYVALUE WITH
title_id
SQLMAP FOR price SQLTYPE Money
;
COLLECTION_CLASS ArrayTitle COLLECTION_TYPE ARRAY ELEMENT_CLASS
Title
PRIMARY_KEY pub_id
ORDERBY ytd_sales title_id
;
CLASS PubInfo TABLE pub_info
PRIMARY_KEY pub_id
SQLMAP FOR logo SQLTYPE image
SQLMAP FOR prInfo COLUMN_NAME pr_info SQLTYPE text
;
CLASS Publisher TABLE publishers
PRIMARY_KEY pub_id
RELATIONSHIP pubInfo REFERENCES PubInfo BYVALUE WITH pub_id
RELATIONSHIP titles REFERENCES ArrayTitle BYVALUE WITH pub_id
;
CLASS Job TABLE jobs
PRIMARY_KEY job_id
;
CLASS Emp TABLE employee
PRIMARY_KEY emp_id
RELATIONSHIP job REFERENCES Job REFERENCED_KEY PrimaryKey WITH
job_id
RELATIONSHIP publisher REFERENCES Publisher WITH pub_id
;
CLASS TitlePub
PRIMARY_KEY title_id
;
CLASS LinkList TABLE linklist
PRIMARY_KEY link_id
RELATIONSHIP next REFERENCES LinkList BYVALUE WITH next_link_id
;
```

**FIGURE 18**  
ORM Specification

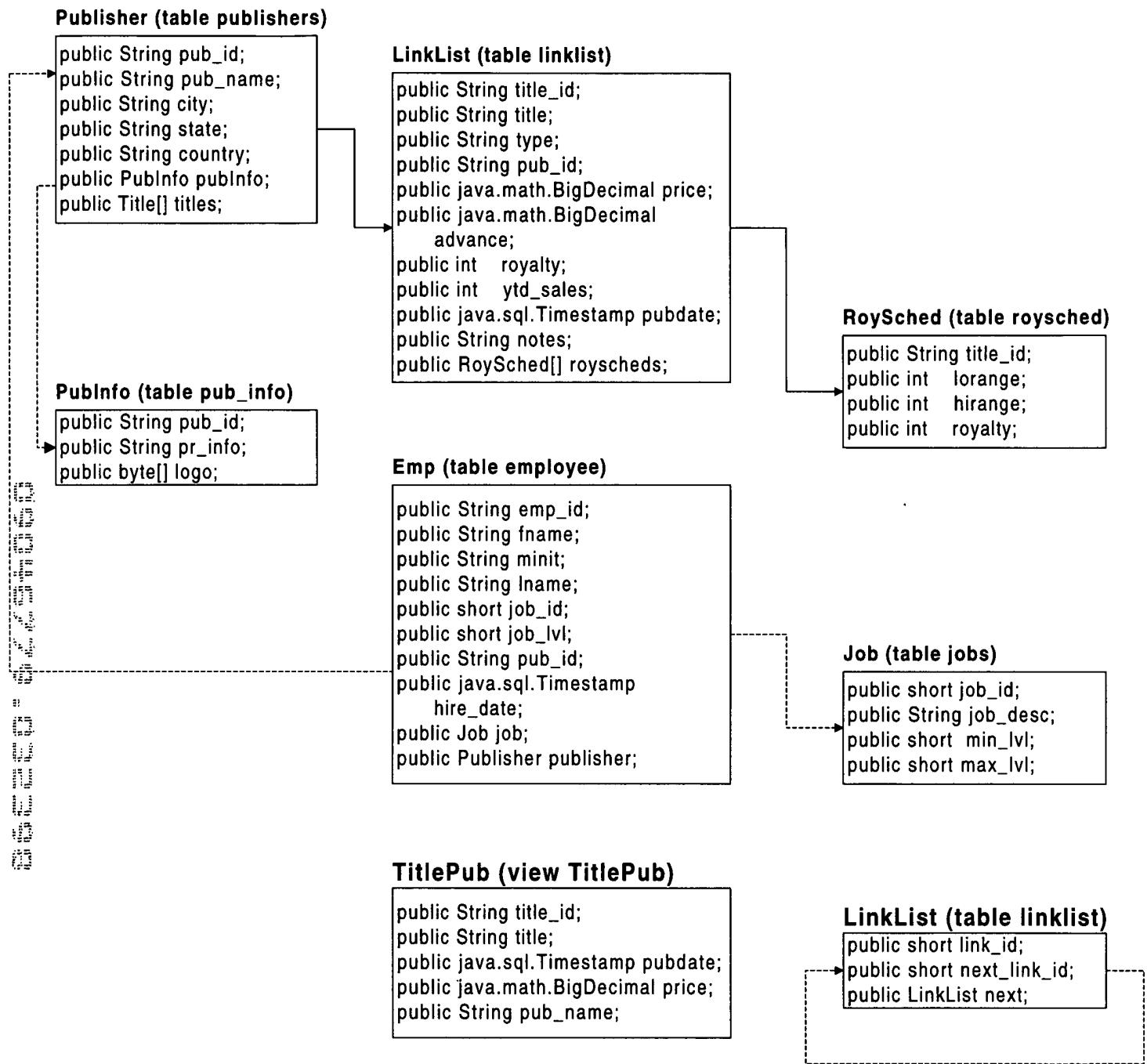


Figure 19  
ORM Spec Graphical rep

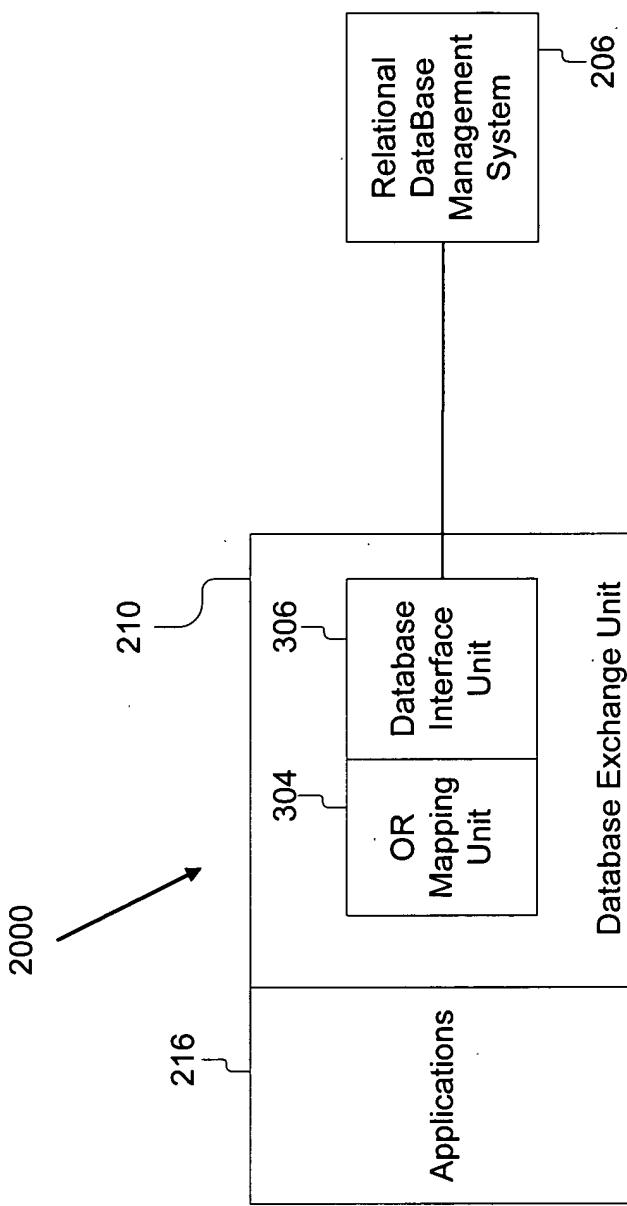


Figure 20A

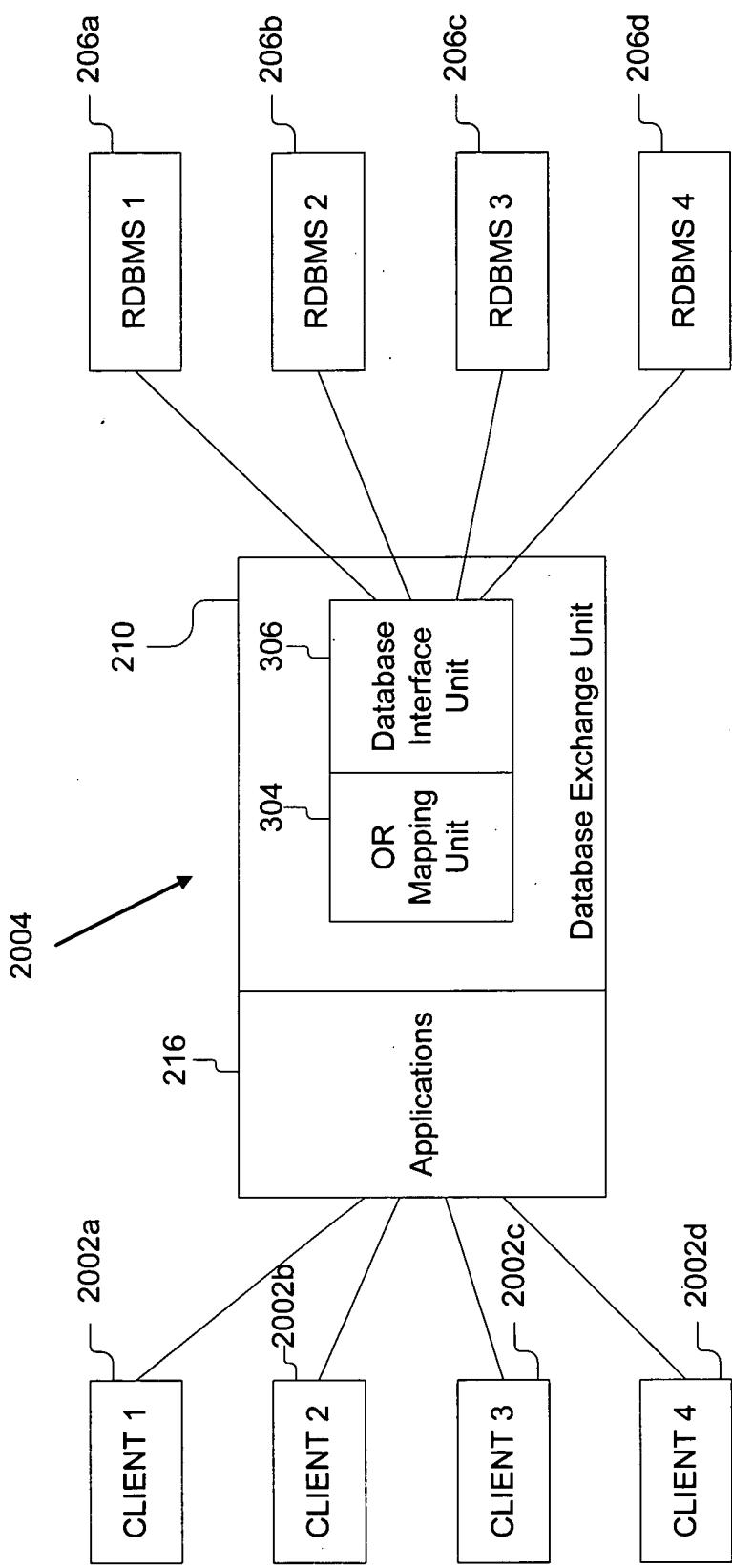


Figure 20B

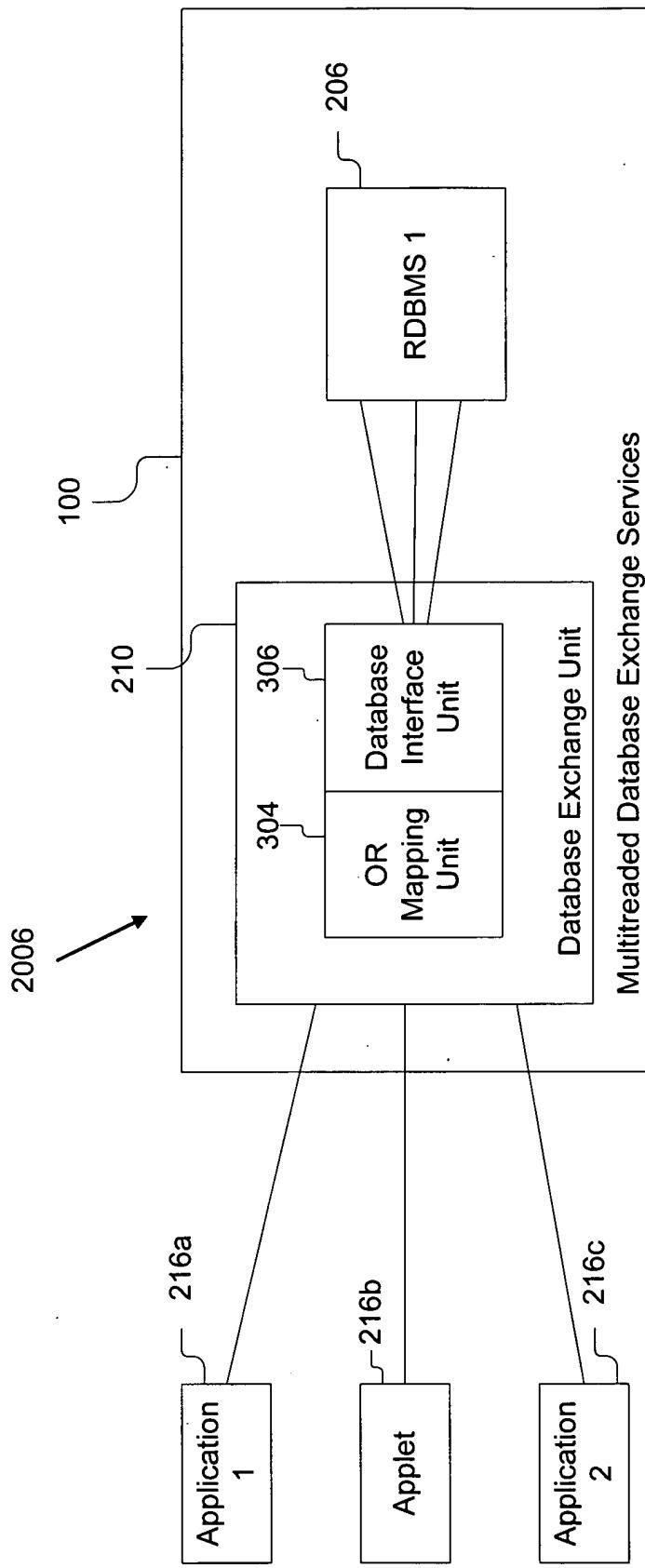
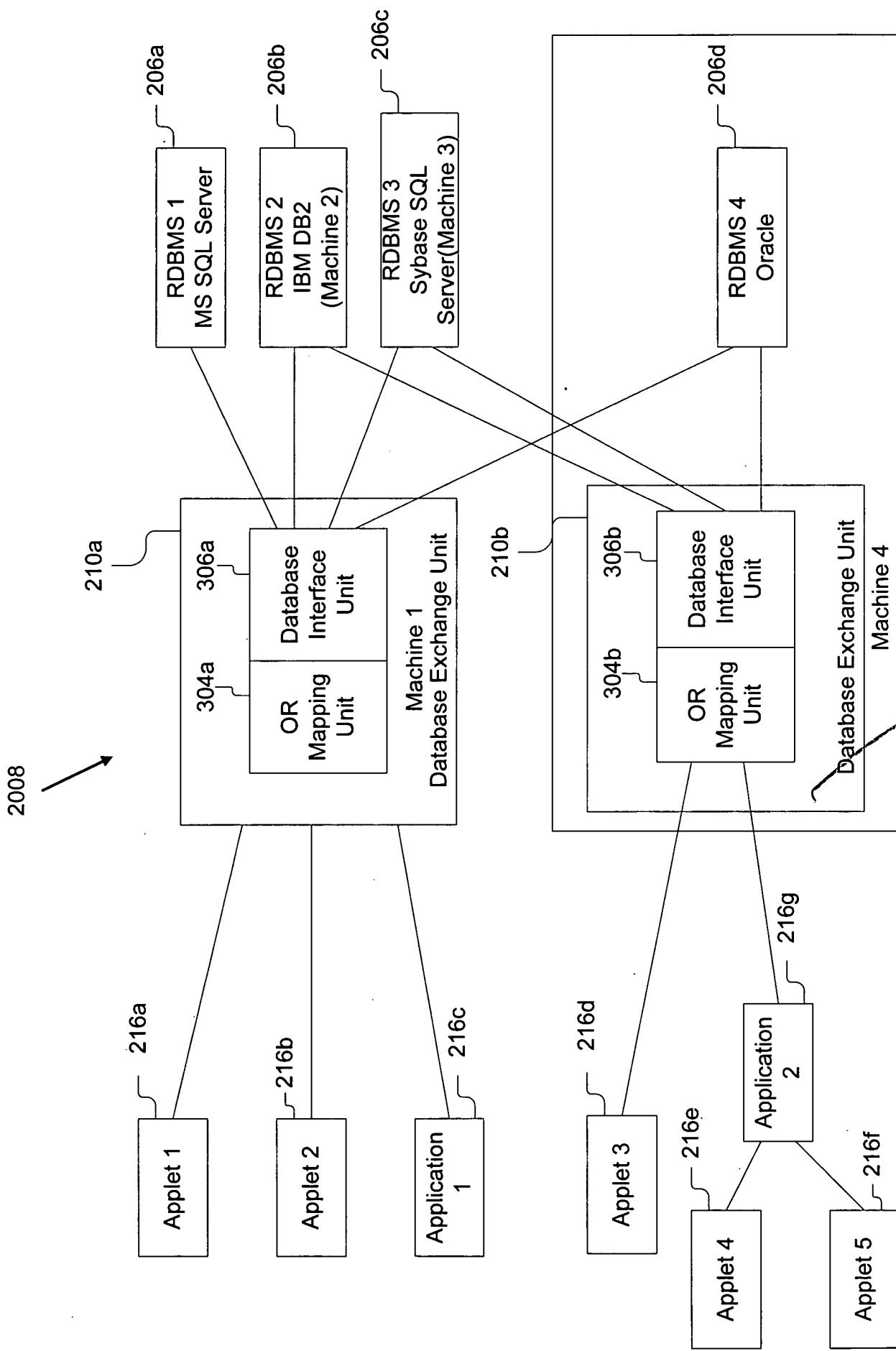


Figure 20C



**Figure 20D**

FIGURE 21A

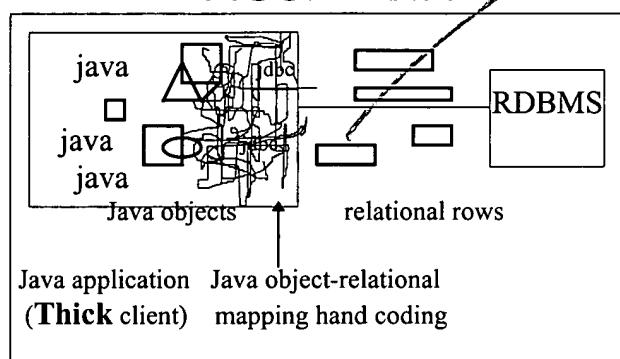
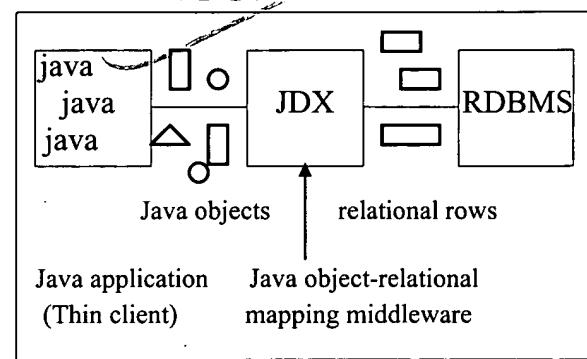


FIGURE 21B



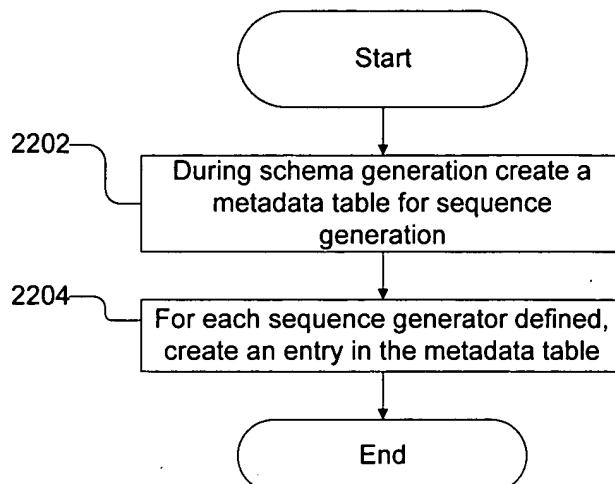


Figure 22A

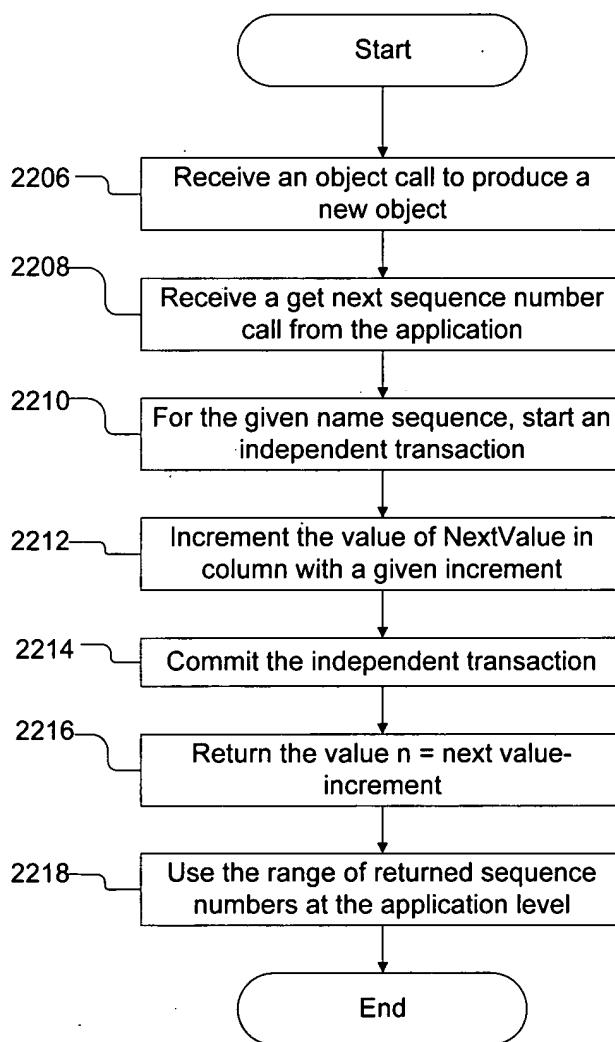


Figure 22B

Method for Generating and using  
Named Sequence Generators